

Newsletter

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I would argue that science, ethics and an enlightened public are critical components in developing wise answers ... which are critical to the survival of human societies.

Gene E. Likens, Director

One of the principal goals of the Institute of Ecosystem Studies is the dissemination and application of knowledge about ecological systems. Accelerating environmental change makes the need for these efforts even more urgent: it is becoming increasingly important to make the general public, and public policy makers, aware of how closely the quality of human life is tied to living systems and their complex interactions.

Science writers and others attended a one day media briefing here in June (see story on this page). They took away an understanding of current IES research and an awareness of the Institute as a resource for their own science writing. In exchange, IES ecologists gained insight into more effective ways to communicate their science.

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On the Edge of Science

Probably even the most casual observer can describe features of forest edges. Some are abrupt, having been created recently by, say, the clearing of a lot for a new building. Others, having been around longer, are a gradual transition between forest and field, with some characteristics of both and more than likely some that are found in neither. Bird-watchers flock to forest edges because their quarry sing from high perches overlooking the more open fields. Patient eyes will spot woodland wildlife along edges as well, cautiously venturing out to feed or returning to the forest interior for cover.

Ecologically, while much has been described about forest edges (see box on page 2), there is much yet to be learned. What is their role in forest regeneration? How do they function as a boundary? How do they inhibit or enhance movement of animals, seeds and nutrients? To address these questions, IES ecologists Dr. Steward Pickett and Dr. Mark McDonnell (now director of the Bartlett Arboretum in Stamford, Ct.) developed a study to learn how the structure — the architecture — of a forest edge relates to its function. Collaborating on the project from the start was Mary Cadenasso, a graduate student of Dr. Pickett's enrolled in a doctoral degree program at Rutgers University and the Institute of Ecosystem Studies.

How It's Done

To examine the link between structure and function, the scientists selected forest edges on the grounds of the Mary Flagler Cary Arboretum, one on Tea House Hill and the other at the field behind the Greenhouse. Within the research sites, measuring 100 x 100 meters (approximately 110 x 110 yards) each, they created paired plots — one control, one experimental — with a buffer zone in-between. Then, from the edge to 20 meters (65 feet) into the forest on just the experimental plot at each site, the IES grounds crew cut away lateral branches of the canopy trees as well as small trees and shrubs that were lower than half-canopy height. This alteration of the structure of the forest edge enabled a test of how edge structure is linked to edge function.

Next, on each of the paired plots and at three distances into the forest from the edge, Ms. Cadenasso established small plots for herbivory studies. Finally, with the help of research assistants Julie Hart and Mike Traynor, she planted *Acer rubrum* (red maple), *Quercus rubra* (northern red oak) and *Ailanthus altissima* (tree of heaven) seedlings.

continued on page 2

Science and the Media: IES Briefing

Representatives from the media met at the Institute on June 10 to learn about IES research and to explore field study sites. After introductory remarks by Ms. Gretchen Long Glickman, chairman of the IES Board of Trustees and Dr. Thomas E. Lovejoy, chairman of the Scientific Outreach Committee (page 3), four Institute ecologists described their research programs and concerns.

Dr. Richard S. Ostfeld spoke about the ecological relationships that he and his colleagues have discovered relating to Lyme disease. Dr. Michael L. Pace summarized research in the Hudson River with respect to the zebra mussel invasion. Dr. David L. Strayer's talk on "America's Disappearing Freshwater Shellfish" included slides showing some of these animals' fascinating strategies for survival.

continued on page 3

One of six field research experiences for representatives from the media was "Forests on the Edge". From left to right: foreground, Mr. Peter Berle, "The Environment Show", WAMC, Northeast Public Radio; rear, Mr. Ted Spiegel, photographer and writer, with Dr. Steward Pickett, IES; Mr. Richard Wager, Gannett East and Poughkeepsie Journal, and Ms. Mary Cadenasso, IES. (The research of Ms. Cadenasso and Dr. Pickett is described in "On the Edge of Science", above.)



Since herbivory has a major impact on seedling growth, one of the things the scientists wished to measure was the effect of the cut on the herbivore community and the resultant influence on forest regeneration. For each planting of unprotected tree seedlings, therefore, an equal number of seedlings were planted and covered by a cage; the latter, protected from herbivory, were the controls for external forces such as temperature and moisture that could affect plant growth and survival. Initial findings, to be presented at the August 1996 meeting of the Ecological Society of America (ESA) in Providence, R.I., show that small mammal herbivory is greater on the intact edge, where there is cover, while deer prefer to browse seedlings on the cut edge.

The sites are being used for other studies as well. Each has over 350 small rectangular permanent plots on which the herbaceous community is measured. Ms. Cadenasso marked the plots in summer 1994, mapping tree seedlings and recording their heights, and estimating percent cover of all species. Each summer she spends approximately one month revisiting the plots to measure changes in species composition and cover, and seedling turnover. The data contribute to a long-term record of edge and forest change.

Atmospheric Deposition and the Edge

From an atmospheric perspective, a forest edge is a wall: wind moving essentially unobstructed across a field meets the trees and causes air turbulence that results in particles and gases in the air being deposited on leaf surfaces. Since trees along the edge have more side branches and more leaves than trees in the forest interior, the magnitude of this so-called dry deposition potentially is increased. Ms. Cadenasso invited Dr. Kathleen Weathers to become a collaborator, to contribute her expertise with atmospheric deposition. (Dr. Weathers, whose research in the Catskill Mountains was featured in the May-June 1996 issue of the IES NEWSLETTER, did her dissertation research on atmospheric deposition to high elevation forest edges).

Dr. Weathers and Ms. Cadenasso did a pilot study in summer 1995 to measure any enhancement of nutrients — specifically calcium, nitrate, ammonium and sulfate — at the forest edge compared to the forest interior. While research of this type has been done in Europe, this was the first time it had been done in low elevation deciduous forests of North America.

Chemicals deposited on leaf surfaces via dry deposition and rain are carried to the

forest floor in throughfall, rainwater dripping through the canopy. In the pilot study, collectors — basically a funnel and a water container — were placed at several locations along the edge and in the forest interior, and samples were analyzed for nutrients. Results showed an average of an approximately 40% increase in nutrients reaching the forest floor at the edge, data that Dr. Weathers will present at the upcoming ESA meeting. Continuing studies based on these data will measure the impact of increased nitrogen on seedlings at the forest edge, and the implications for forest regeneration both at the edge and in the interior.

REU Student Measures Throughfall Effects

Working with Dr. Pickett, Dr. Weathers and Ms. Cadenasso is Research Experiences for Undergraduates (REU) student Courtney Pegus. (See the story about the Institute's 1996 REU program on page 3.) Mr. Pegus, who will be starting his junior year at Morehouse College in Atlanta, Georgia this fall, has designed a project to address one aspect of the throughfall question. By comparing the growth rate of tree seedlings exposed to forest edge conditions vs. forest interior conditions, he hopes to measure the effects of nitrogen from throughfall.

Mr. Pegus dug soil from the canopy edge and from an area 25 meters (just over 80 feet) into the forest, trucked it to the IES greenhouse and potted it. He then planted *Betula lenta* (black birch), *Acer rubrum* and *Ailanthus altissima* seedlings, half of them



MOLLY AHEARN

REU student Courtney Pegus measures seedling growth to learn the effects of nitrogen along the forest edge.

in edge soil and half in soil from the forest interior. For the remainder of his study, he will water the seedlings in one of three ways. As a control, one group of plants in each soil type will receive deionized water, which has no extra nitrogen. Another group will be given water with a nitrogen level equivalent to that of forest interior throughfall. The third group will be treated with water that is 50% higher in nitrogen, simulating that of edge throughfall. All groups will get the same amount of sunlight. Mr. Pegus will record seedling growth at regular intervals. His hypothesis is that the seedlings planted in soil from the forest edge and treated with water that simulates edge throughfall will grow fastest, because these seedlings will be exposed to the highest amounts of nitrogen.

Whether this prediction is borne out is yet to be seen at this writing. Mr. Pegus will present his results at the upcoming Undergraduate Research Symposium.

The forest edge — that relatively narrow strip of the landscape that lies between a forest and a grass or shrub community — is a transition zone where physical conditions such as light, soil type, moisture levels and/or temperature differ from those of the adjacent communities. The magnitude of change in biotic and physical parameters between two or more communities is called the "edge effect". Some of the more generalist plant and animal species often colonize and survive in the edge, and species not found in any of the bordering communities may thrive there as well; thus, the edge is a unique habitat in itself. In the past, the depth of the edge effect into the forest generally was considered to be 20 meters (65 feet). Ecologists now consider an edge to be a very fluid zone depending on the variables considered, the bordering habitats, and the structure of the edge itself.

The concept of the edge effect was developed by the renowned wildlife ecologist, naturalist, conservationist, writer and teacher, Aldo Leopold, in a 1933 book about game management:

Game [wildlife] is a phenomenon of the edges. [Wildlife] occurs where the types of food and cover which it needs come close together, i.e., where their edges meet ... We do not understand the reason for all these edge effects, but in those cases where we can guess the reason, it usually harks back to the desirability of simultaneous access to more than one environmental type, or the greater richness of border vegetation, or both.

Research Experiences for Undergraduates - 1996

Nine college undergraduates are collaborating with IES ecologists this summer in the Research Experiences for Undergraduates (REU) program. Funding from the National Science Foundation (NSF)* since 1988 and from the Andrew W. Mellon Foundation since 1994 has made it possible for these students, and for 74 others before them, to do three months of independent research in ecology at the Institute, and to learn career-related skills at the same time.

REU students work closely with a scientific mentor, designing their own studies, doing field and/or laboratory research and analyzing results. At the end of the summer they present their findings at a symposium attended by Institute staff; the public is also invited to attend. This year's symposium is on August 20. Final reports are published as an IES Occasional Publication.

One goal of the IES REU program is to

** The goal of NSF in developing the REU program in the mid-1980s was to improve science education in the U.S. and to help assure an adequate supply of top-notch scientists, mathematicians and engineers for the future. Many institutions compete for annual NSF funds to support REU students, and the Institute of Ecosystem Studies has been among the recipients for nine consecutive years.*

help students get a head start in ecology-related careers. At a July "Forum on Opportunities in Ecology", REU participants, together with students from nearby colleges and universities, meet at the Institute with professionals from science-related positions in environmental laboratories, academia, industry, government, law, the media and more. This summer, making use of the teleconferencing facilities in the IES Auditorium, REU program coordinator Ms. Stephanie Shoemaker arranged for 18 REU students at the University of Massachusetts/Boston to participate actively in the forum from over 150 miles away.

The REU participants learn practical "life skills" as well. Weekly seminars focus on Research Strategies, including planning a project, statistics, making slides for presentations and communicating research results, and Research-in-Context, to help students put their own research into the broader perspective of the discipline of ecology. Project directors Drs. Alan Berkowitz, Stuart Findlay and Steward Pickett from IES and Dr. Charles H. Nilon from the University of Missouri-Columbia also meet with the students to discuss strategies for graduate school and job hunting.

1996 REU Students, Research and Mentors

Enrique Cachafeiro (U. of N.C. at Asheville): *Effects of the urban-rural gradient on white-footed mouse populations.* Dr. C.H. Nilon, mentor.
Rachel L. Collett (Mount Holyoke College, Mass.): *Determining the functional response of the white-footed mouse to low gypsy moth populations.* Drs. C.G. Jones and R.S. Ostfeld
Jennifer Funk (U. of Calif. at Berkeley): *Effects of defoliation on isoprene emission and carbon balance in the Eastern cottonwood.* Dr. C.G. Jones
Jamil S. Ibrahim (SUNY, College of Environmental Studies and Forestry): *Limiting factors of denitrification in the hyporheic zone.* Dr. S.E.G. Findlay
Andrea Kudrez (Bowdoin College, Me.): *Effects of nitrogen fertilization on the refoliation of red oaks.* Dr. G.M. Lovett
Sibylle Otto (Brown Univ., R.I.): *Effects of nitrogen enrichment and vegetation type on microbial processes in a freshwater marsh.* Dr. P.M. Groffman
Courtney C. Pegus (Morehouse College, Ga.): *The role of nitrogen from throughfall on tree seedling growth.* Drs. S.T.A. Pickett and K. C. Weathers and Ms. M.L. Cadenasso
Katherine D. Prescott (Johns Hopkins Univ., Md.): *Effects of zebra mussel density on benthic macroinvertebrate communities.* Dr. D.L. Strayer
Mark G. Sanford (Univ. of Missouri, Columbia): *Effect of water chestnut density on fish composition and abundance in a Hudson River tidal marsh.* Drs. C. Wigand and S.E.G. Findlay



Sharing Science: Pond Ecology at Cary Pond

IES Research Experience for Undergraduate students participated in "near-peer" teaching when they spent a morning working with 30 ninth- to twelfth-graders from the Liberty Environmental Science Academy (LESA). LESA, a joint program of Bank Street College of Education, New York City and Bard College, Annandale, N.Y., provides the opportunity for New York City students to spend two weeks each summer at Bard, focusing their attention on ecology and natural history.

The REU students set up stations to test the physical, chemical and biological properties of Cary Pond and the LESA students rotated through the three stations to get a complete picture of the pond ecosystem. At the end of the session the Liberty students drew conclusions about the health of the pond, based on their findings and observations. Above: At the chemical station, REU students Jamil Ibrahim and Jennifer Funk, right, explain how to measure pH and dissolved oxygen.

Media Briefing, from page 1

And Dr. Steward T.A. Pickett concluded the presentation with a discussion of conservation of ecosystems and biodiversity, and an announcement of the publication of *Ecological Basis of Conservation* by Drs. Pickett, Ostfeld, Moshe Shachak and Gene E. Likens.

After lunch, media representatives, members of the Institute's Scientific Outreach Committee* and IES scientists met in a round table discussion to examine strategies for better communication between scientists and science writers. At the end of the day, guests were invited to visit one of six different field research sites.

* IES Scientific Outreach Committee:

Dr. Thomas E. Lovejoy (chairman), Counselor for Biodiversity and Environmental Affairs, Smithsonian Institution, and IES trustee; Mr. Samuel Hamill, regional planner and trustee of the Baldwin Foundation; Mr. Alan McGowan, President of Media Resource Service and Director of Public Understanding of Science with the American Association for the Advancement of Science; Mr. Hamilton Meserve, Publisher of the Taconic Newspapers and President of Taconic Media, Inc.; Mr. Gerard Piel, retired editor of *Scientific American*; Dr. Lee Talbot, head of Lee Talbot Associates and IES trustee; and Mr. Richard Wager, Vice President of Gannett East and Publisher of the *Poughkeepsie Journal*.

Calendar

CONTINUING EDUCATION

For fall semester catalogues and program information, call the Continuing Education office at 914/677-9643. Early fall programs include:

Landscape Design

Sept. 13 and/or 20: **A Professional House Call to Your Landscape**

Sept. 19 (6 sessions): **Ecological Landscape Design: Successful Design with Native Plants**
Gardening

Sept. 15 & 22: **Insect Pests and Diseases of Plants**

Sept. 21: **Tools for the Garden**

Sept. 28: **Cold Frame Rewards**

Sept. 28 & 5 Wed.: **Herbaceous Perennials**
Natural Science Illustration

Sept. 9 (6 sessions): **Drawing I**

Sept. 17 (4 sessions): **Autumn Splendor in Waterecolors**

Workshops

Sept. 28: **Pond Management and Restoration**
Other Courses

Sept. 17 (8 sessions): **Basic Botany**

Sept. 18, 21 & 22: **Bird Identification, Ecology and Banding**

Sept. 18 & 21: **Mushrooms in the Fall**
Excursions

Sept. 8: **Canoe Exploration/Constitution Marsh**

Sept. 15: **Shawangunks/Ancient Ice Caves**

Sept. 22: **Tornado Recovery in Cathedral Pines**

Sept. 29: **Paugussett Archaeological Dig**

Sept. 30: **Ecology Cruise on the Norwalk River**
Natural Crafts

Sept. 16 (8 sessions): **Woodcarving from Nature**

SUNDAY ECOLOGY PROGRAMS

Free public programs are held on the first and third Sunday of the month, except over holiday weekends. Call 914/677-5359 to confirm the day's topic or, in case of poor weather, to learn the status of the day's program. The following programs begin at 2 p.m. at the Gifford House:

Aug. 18: **Weather Monitoring at IES**, a program led by Ms. Vicky Kelly

Sept. 15: **Fall in the Fields**, a walk led by Dr. Steward Pickett

IES SEMINARS

Free scientific seminars are held each Friday at 3:30 p.m. at the IES Auditorium:

Sept. 13: **Escape and Defense in Native Nicotiana**. Speaker: Dr. Ian T. Baldwin, SUNY/ Buffalo

Sept. 20: **The Influence of Geomorphological Heterogeneity on Biodiversity: Patterns at Patch and Landscape-scale Analyses**. Speaker: Dr. Peter V. August, Univ. of Rhode Island

Sept. 27: Title to be announced. Speaker: Dr. John Harte, Univ. of California/Berkeley

VOLUNTEER OPPORTUNITIES

The IES Education Program needs volunteers. Opportunities are available now assisting with the Volunteer Program itself, as well as in public information, in the Gift and Plant Shop, and in the Education Program administrative office. In the fall, volunteers will have the chance to help with ecology education programs for school groups. For information on responsibilities and benefits, call Ms. Su Marcy at 914/677-5359.

GREENHOUSE

The IES greenhouse, a year-round tropical plant paradise and a site for controlled environmental research, is open until 3:30 p.m. daily except public holidays. Admission is by free permit (see "HOURS").

HOURS

Summer hours: May 1 - September 30

Closed on public holidays.

Public attractions are open Mon. - Sat., 9 a.m.-6 p.m. & Sun. 1-6 p.m., with a free permit*.

The IES Gift and Plant Shop is open Mon.- Fri., 11 a.m.-5 p.m., Sat. 9 a.m.-5 p.m. & Sun. 1-4 p.m. (The shop is closed weekdays from 1-1:30 p.m.)

* Free permits are required for visitors and are available at the Gift Shop daily until 5 p.m.

IES GIFT AND PLANT SHOP

New in the Shop ... Four new Brooklyn Botanic Garden handbooks ... mulberry tree paper frames and boxes ... for children ... finger puppets: mouse, beaver, goose, chipmunk, frog, skunk, turtle ... puzzles ... and in the Plant Shop ... Ecospouts... wind chimes

Senior Citizens Days: 10% off on Wednesdays

•• Gift Certificates are available ••

MEMBERSHIP

Join the Institute of Ecosystem Studies. Benefits include a member's rate for courses & excursions, a 10% discount on Gift Shop purchases, a free subscription to the newsletter and participation in a reciprocal admissions program. Individual membership: \$30; family membership: \$40. Call Ms. Janice Claiborne at 914/677-5343.

The Institute's Aldo Leopold Society

In addition to receiving the benefits listed above, members of The Aldo Leopold Society are invited guests at spring and fall IES science updates. Call Ms. Jan Mittan at 914/677-5343.

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